Title: Measuring the Economic and Agronomic Benefit of Timed, Preventative Fungicide Applications to Soybean

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Abstract: Preventative soybean fungicides Headline and Quadris were applied to soybeans at the R3 growth stage at two farm scale research sites in Seneca County, NY. Results of this research indicate that the amount of disease present did not justify fungicide application for disease control, and fungicides did not reduce disease incidence or severity of Septoria brown spot or downy mildew. Partial budget analysis indicates a net loss in profit per acre when fungicides are applied in the absence of Asian Soybean Rust, and at non-economic levels of other common foliar diseases, as a preventative tactic. Results show that wheel damage from application equipment traffic can constitute a significant loss in yield. This study was done for one season only and needs to be repeated to further evaluate the use of foliar fungicides for a growth enhancement effect under another set of environmental conditions. Having the means and/or equipment to apply fungicides in the event of occurrence of Asian Soybean Rust must remain a consideration for soybean producers.

Background and Justification: For many farmers, soybeans fit well with their field crop rotations, provide a useful homegrown source of livestock feed, and offer a valuable cash crop option. In New York State, soybean acreage has increased over 5 fold since 1989 with an estimated 200,000 acres planted in 2006 (NYS Ag Statistics Service). The trend in soybean acreage expansion will likely continue as local markets are enhanced by availability of commercial roasters and oil processing plants.

Until recently, soybean pest concerns have been minimal in NY. For years, many pest impacts were largely minimized or avoided through an integrated approach based on selecting varieties for maturity group, disease resistance, and commercial commodity attributes and the timely implementation of sound agronomic practices including crop rotation. As soybean acreage across NY has risen, and with intensified weed, insect, and added disease problems, a need for increased awareness and education of soybean pest management has arisen. The detection of Asian soybean rust in the southeastern US in 2004 led to concerns about how rust would impact soybeans in the 2005 growing season. Farmers were targeted with educational materials and marketing information about fungicides. Despite consistent advisories from Cornell University, USDA, and Cooperative Extension that fungicide application for protection against soybean rust was not warranted in NY in 2005, protectant fungicide application during the early reproductive stages (R1-R3) of soybean growth was encouraged. The purported benefits of this application were protection against potential soybean rust attack and the general improvement of “plant health". Industry-generated data suggests that fungicide applications at a designated stage of plant development results in a "yield bump" due to increased plant health. Quadris (Syngenta Crop Protection, Inc.) and Headline (BASF) are two chemicals being promoted and marketed to farmers. Research from replicated small plot studies does not show statistically significant yield enhancement when strobilurin fungicides are applied to soybean at R1-R4 stage of physiological development [Vol. 60, Articles FC077, FC082, FC097, and FC140 in Fungicide & Nematicide Tests (online at http://www.plantmanagementnetwork.org/pub/trial/fntests/vol60/)]. Replicated on-farm NY field data is not currently available to assist growers in making educated economic choices regarding a calendar spray of fungicides in the absence of Asian soybean rust

Field crop producers asked many questions in 2005 regarding fungicide use, including a farmer who assessed untreated strips at harvest in 2005 to determine the value of fungicides for plant health on his farm. While results from 2005 side-by-side strips provided useful preliminary information, this farmer recognized that a replicated trial will provide more reliable results, and he helped to initiate this research. Additional motivation for conducting this work came from the Livestock Field Crop IPM working group Priorities, which lists "Determine the value (disease control, yield, and economic return) of foliar fungicides" as a high priority for IPM research and development in soybean.

In addition to assessing the value of fungicide materials for yield enhancement, we examined the economics of applying a spray treatment to soybean fields. When pesticide application is considered in a soybean field, a major factor in the decision to spray or not deals with the loss of yield from destruction of plants that are driven over. The typical assumption about how much yield loss that occurs in soybeans in 7-inch rows simply by driving through the field with the spray rig (traffic loss) has been approximately 3 to 4 bushels per acre. This research sheds light on this assumption.

In 2005, the NYS Integrated Pest Management Program's Tactical Agriculture (TAg) Team model for season-long on-farm education programs was successfully adapted to cover pest and crop management topics in soybeans. This effort continued in 2006, and will likely continue in 2007. Participating growers will benefit from results of this research. Wider state and national audiences also will benefit from the results of this work through extension outreach efforts.

Objectives:

1. To work with participating farms to develop research strategies, to plan on-farm trials, and to establish on-farm field scale research plots.
2. To monitor plant growth parameters and monitor disease incidence before and after treatment with foliar fungicides.
3. To collect yield and other pertinent data at harvest time.
4. To conduct an economic analysis of results for each treatment on each farm.
5. To conduct extension education efforts based on research results.
6. Project evaluation

Procedures:

Research plots were custom designed for three farms in Seneca County based on field sites available and farm equipment resources for site preparation, planting, and application of foliar spray. Following planting, plot establishment, and initial plant stand counts, one of the three participating growers was not able to follow through on the demands of the experiment. All procedures, results, and discussion are based on two farms only. Field size and plot size for both farms are outlined in Table 1. Both fields were no-till planted.

Table 1. Descriptions of Field Sites

Producer	Location	Field Size	Plot size	Planting date	Variety	Row spacing
M. Lott	Seneca Falls	32 acres	0.5 acre	10 May 2006	Pioneer 93B36	15 inch
D. Freier	Waterloo	20 acres	0.9 acre	9 May 2006	Pioneer 93B36	7 inch

Each field was designed in strip plots as a randomized block layout with 5 replications and 4 treatments. The four treatments were an untreated check, application of Headline fungicide at a rate of 6 ounces per acre, application of Quadris fungicide at a rate of 6 ounces per acre, and a trip with the application equipment (with no fungicide treatment in order to assess traffic loss). Headline and Quadris are labeled in NY for preventative treatment of Asian Soybean Rust and other foliar diseases on soybean.

Fertility at each site was determined based on a complete soil analysis, and recommendations from Cornell Nutrient Analysis Laboratory were followed. Relevant weather data was collected at each site throughout the growing season.

INITIAL PLANT STAND ASSESSMENT: Initial plant populations were determined on 10 and 11 July 2006 at the Lott site and on 14 July 2006 at the Freier site to serve as a baseline for determining traffic losses and harvest populations. Estimates of number of plants per acre were made at each field site. At the Lott site, planted in 15-inch rows, number of plants in 35 feet, 10 inches of row, representing 1/1,000 of an acres, were counted in 8 rows in 15 locations across the field. At the Freier site, planted in 7-inch rows, the hula-hoop method of estimating plant populations was used. Numbers of plants within a 30-inch diameter hoop were counted in 20 locations across the field. Numbers were multiplied by 8890, a factor used to convert number of plants within the 30-inch hoop to number of plants per acre.

DISEASE ASSESSMENT PRIOR TO FUNGICIDE APPLICATION: Initial assessment of foliar fungal diseases was conducted on 26 and 27 July 2006 at the Freier site and on 27, 28, and 31 July 2006 at the Lott site. Soybean plants were at the R-2 growth stage. Because no treatments had yet been imposed, relatively uniform distribution of diseases was assumed across each field. Therefore, assessments were conducted at 20 locations across each field to gain a representative estimate of diseases. At each of the 20 sites, 10 plants were observed. For each observed plant, the following information was recorded: 1) total number of leaflets; 2) disease incidence: number of leaflets with brown spot and number of leaflets with downy mildew; 3) disease severity: percentage of leaf area affected by brown spot and percentage of leaf area affected by downy mildew; and 4) other diseases present. Percent of leaflets with brown spot, percent of leaflets with downy mildew, percent of leaf area with brown spot, and % of leaf area with downy mildew were calculated from these observations.

FUNGICIDE APPLICATION: Fungicide applications took place on August 9, when the soybeans were at the late R-3 stage of growth (when pods were 3/16" at the uppermost node). Application of product and the equipment damage treatment was done with a John Deere 4710 self propelled spray rig. Sprayer set up and application to treatments was the same at both the Freier and Lott site, however a narrower boom width was used at the Freier site. The JD 4710 is equipped with a 90 foot application boom. In each case boom width was modified to fit the specifications of the harvester (described below). At the Freier site a 35 foot pattern was used and similarly a 50 foot pattern utilized at the Lott site. In each case this allowed for a full harvester pass within each treatment and allowed for a nearly full harvester pass on the adjoining buffer areas, essential to maximize use of the farmer's time and equipment. Other application equipment specs included a ground speed of 8 mph, operating pressure of 35 – 40 psi, 20 gallon per acre carrier, TeeJet 60 nozzles, and 6 oz per acre product application rate. Both Quadris and Headline were applied at a rate of 6 oz per acre.

DISEASE ASSESSMENT FOLLOWING FUNGICIDE APPLICATION: Common foliar fungal diseases were assessed for incidence and severity beginning two weeks post-spray. Assessment was conducted on 21, 22, and 24 August 2006 at the Freier site and on 24, 25, 28, and 30 August 2006 at the Lott site. Soybean plants were at the R-5 growth stage. Five plants were observed at three sample locations within each plot. Samples locations were at regular intervals within each strip plot (determined by counting number of paces from the front of each plot). As was done prior to spray, the following information was recorded for each observed plant: 1) total number of leaflets; 2) disease incidence: number of leaflets with brown spot and number of leaflets with downy mildew; 3) disease severity: percentage of leaf area affected by brown spot and percentage of leaf area affected by downy mildew; and 4) other diseases present. Percent of leaflets with brown spot, percent of leaflets with downy mildew, percent of leaf area with brown spot, and % of leaf area with downy mildew were calculated from these observations. Disease incidence (percent of leaflets with disease symptoms) and severity (percent of leaf area with disease symptoms) were compared among treatments using analysis of variance.

SOYBEAN APHID ASSESSMENT: To assess the potential impact of fungicides on entomopathogenic fungi that control soybean aphids, numbers of aphids per plant were counted on each plant assessed for disease incidence and severity both before and after fungicide treatments. Analysis of variance was used to determine differences based on treatment.

FINAL PLANT STAND ASSESSMENT AND POD COUNTS: Plant populations were assessed when plants were close to final maturity on 10 October 2006 at the Lott site and on 12 October 2006 at the Freier site. The same methods described in the initial plant stand assessment were used to estimate plants per acre in 2 locations in each strip plot. Numbers of pods per plant were counted on five plants at each location where plant population was assessed. Analysis of variance was used to determine differences in pod numbers and plants per acre based on treatment.

YIELD ASSESSMENT: Harvest at both sites was completed considerably later than anticipated due to wet weather and farm priorities. The Freier site was harvested on 30 and 31 October 2006. A John Deere 9560 with 18- foot flex head was used for the harvest. The Lott site was harvested on 7 November 2006 using a John Deere 9560 equipped with a 25 foot flex head. Harvest technique was the same at both sites. In each case the combine harvested the center from each treatment. State certified drive on scales and six wheel dump trucks were used at the Freier site to attain harvest weights. Intentions at the Lott site were for a calibrated weigh wagon to be used to collect treatment harvest weights. The weigh wagon broke down and rain was in the forecast, thus the combine yield monitor was used to record weights of individual treatments. Based on prior harvests at the Lott farm the yield monitor was calibrated with checked weights reported from the farm's drive on scale over the course of the harvest season. All harvest weights were corrected to 15% moisture content. A sub-sample of soybean seed was taken from each plot for quality analysis. Seed will be analyzed for quality and size, and will be assessed for disease symptoms. Analysis will take place in the winter with the guidance of Cornell Plant Pathologist Gary Bergstrom. Statistical analysis will be conducted to evaluate yield differences among treatments.

PARTIAL BUDGET ANALYSIS: Operational costs associated with the soybean crop were tabulated and deducted against gross returns brought by the marketable crop utilizing current market prices. The gain threshold needed for adoption of the foliar treatments was assessed with the same market price used to determine gross returns. Differences in yield between treatments will be compared to the gain threshold and evaluated as either economically justified or being a depressor of net return.

OUTREACH EFFORTS:
The research results will be distributed to as many soybean growers in New York State as practically possible, and several tactics will be employed. A summary article of the results will be sent to the Cornell Field Crops IN HOUSE e-mail list serve which is accessed by county agents and specialist with crop production responsibilities for distribution in newsletters and websites. Second, the results will be complied into a brochure to be distributed at two region wide Soybean and Small Grain Congresses which together typically reach close to 300 soybean farmers. Third, the brochure and article will be made available at all relevant winter meetings and for use by other agencies and or agri-business. Fourth, opportunities to present the research findings at farmer meetings both locally and around the state will be investigated. Lastly, as the 2007 growing season arrives this material will be distributed and discussed at twilight and other farmer field meetings. Much of the information will be incorporated in the Soybean TAg program for 2007.

Evaluation and impacts of our outreach efforts will be important to determine the effectiveness of our efforts to transfer this specific information to the soybean growers in NYS. We will conduct grower surveys for each educational method described above to assess the value of the information to soybean IPM decision-making. The strong network of County Educators will ensure this information reaches all parts of New York State. The impacts of this project will also reach beyond state boundaries. The data will be included in a national compilation of similar studies. This effort is being coordinated by Arv Grybauskas at the University of Maryland.

Results and Discussion:
INITIAL PLANT STAND ASSESSMENT: Plant population estimates are shown in Table 2. At the Freier site, stand assessments verify that plant stands were generally uniform across treatments.

At the Lott site, plant populations were less in low, wet areas, but these low, wet areas ran the length of the field, similarly affecting each treatment strip.

Table 2. Estimates of Initial Soybean Plant Populations

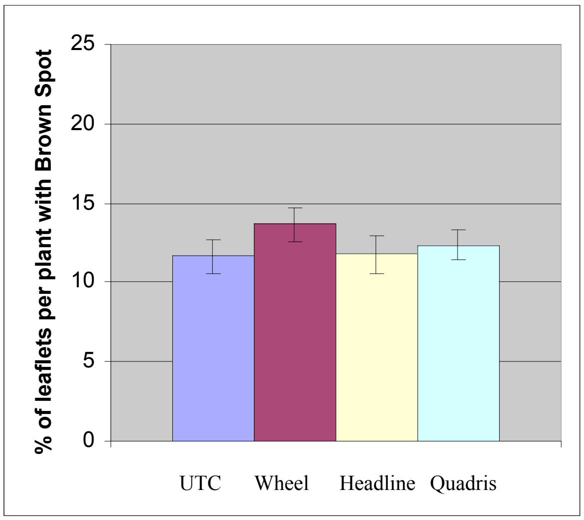
Farm	Date	Population Estimate
Lott	10 & 11 July 2006	67,000 plants per acre
Freier	14 July 2006	141, 650 plants per acre

DISEASE ASSESSMENT PRIOR TO FUNGICIDE APPLICATION: The most frequently observed diseases were Septoria brown spot and downy mildew. At the Lott site, the range of percent of leaflets with brown spot was 14.9% to 27.7 %, with a mean of 21.3%, and the range of percent of leaflets with downy mildew was 0% to 13.3%, with a mean of 2.8%. There was generally as much variation among the 10 plants per sample site as there was across the whole field. Locations with higher average disease were not grouped in any one area of the field. At the Freier site, the range of percent of leaflets with brown spot was 7.3% - 43.9% with a mean of 18%. One of 20 sites had 43.9% incidence of brown spot, almost 15% greater than at any other location in the field. This "hot spot" for brown spot was noted to be in the 4^{th} replication. The range of percent of leaflets with downy mildew was 5.8% to 37.7% with a mean of 23.9%. Aside from the one hot spot, assessments indicated that both diseases were present but not severe across both fields.

DISEASE ASSESSMENT AFTER FUNGICIDE APPLICATION: Brown spot was observed throughout the plant canopy, and downy mildew was most prevalent higher on the plant. Comparisons of percent of leaflets with brown spot and downy mildew are shown in Figures 1A, 1B, 2A, and 2B. At the Lott site, the range of percent of leaflets with brown spot was 11.6% to 13.7% and the range of percent of leaflets with downy mildew was 14.3% to 17.5% (Figure 1A&B). Neither percent of leaflets showing symptoms of brown spot nor downy mildew was significantly affected by treatment. Disease severity, or percent of plant leaf area showing disease symptoms, was very low in all plots. These means ranged from 1.06% to 1.23% brown spot and 0.95% to 1.18% downy mildew. At the Freier site, the range of percent of leaflets with brown spot was 16.0% to 18.5% and the range of percent of leaflets with downy mildew was 5.3% to 9.8% (Figure 2A&B). Percent of leaflets showing symptoms of brown spot was not significantly affected by treatment. Percent of leaflets showing symptoms of downy mildew was significantly lower in the Quadris treatment (Figure 2B; $P=0.003$). Disease severity, or percent of plant leaf area showing disease symptoms, again was very low in all plots. These means ranged from1.6% to 2.2% for brown spot and 0.50% to 0.93% for downy mildew.

Figure 1A&B. Percent of leaflets with symptoms of A. Brown spot and B. Downy mildew at the Lott site in August, 2 weeks after fungicide spray, Means ± SEM; A. Brown spot P=0.508; B. Downy mildew P=0.161.

A.



B.

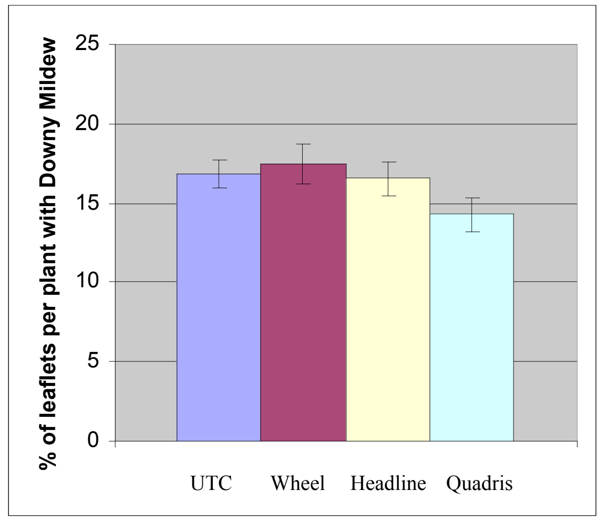
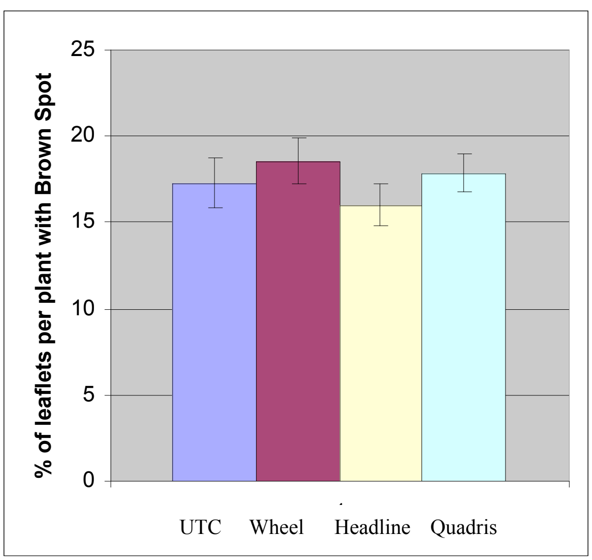


Figure 2 A&B. Percent of leaflets with symptoms of A. Brown spot and B. Downy mildew at the Freier site in August, 2 weeks after fungicide spray, Means ± SEM; A. Brown spot P= 0.565; B. Downy mildew P= 0.003.

A.



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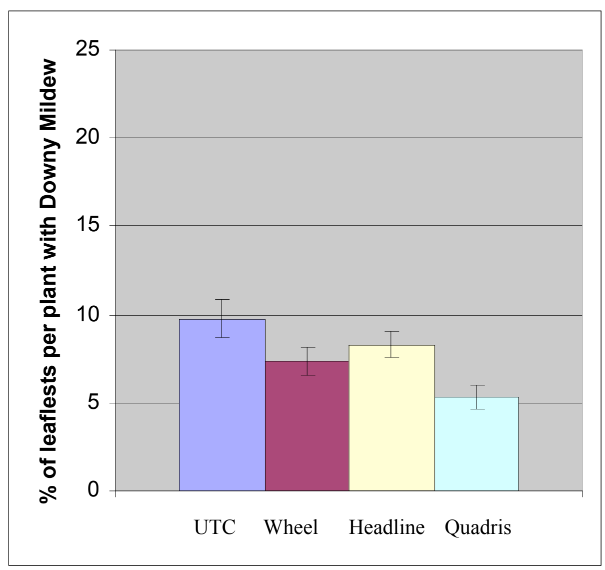


Fungicides in the Strobilurin group, as used in this study, would be unlikely to greatly affect the occurrence of downy mildew. These fungicides should impact the occurrence of brown spot.

Figure 2A shows a trend toward a lower level of percent of leaflets with brown spot in the Headline treatment, but this difference is not significant. The apparent lack of impact of the fungicide treatments on brown spot may be due to the low levels of the disease, variability in disease occurrence, or the potential of lack of penetration of the spray into the plant canopy. Other diseases were observed occasionally, including frog eye leaf spot and bacterial pustule.

SOYBEAN APHID ASSESSMENT: The mean number of soybean aphids observed prior to fungicide treatments was 1.2 aphids per plant at the Lott site and 1.5 aphids per plant at the Frier farm. When soybean aphids were assessed in late August, mean numbers ranged from 17.6 to 29.1 per plant across both farms. At the Freier site, analysis indicated that there were significantly more aphids in the untreated check plots (mean of 21.3 vs. a mean of 14.5 aphids per plant in other treatments). However, these numbers are far below the economic threshold of 250 aphids per plant, and the soybean growth stage was R-5 at the time of aphid assessment, the last stage at which economic benefit can be seen from insecticide application. Therefore, this apparent effect would need to be confirmed by other studies under higher soybean aphid pressure. Soybean aphids that were "fuzzy", pink, or grey, indicating potential infection with a fungal pathogen, were commonly observed in all treatments. Quantitative assessment was not conducted to verify prevalence of infection in each treatment. Future work to further investigate impacts of fungicides on soybean aphid populations is needed.

FINAL PLANT STAND ASSESSMENT AND POD COUNTS: Final plant populations and pod numbers are shown in Tables 3A&B. Plant populations were very low at the Lott site due to wet areas in the field with poor plant survival. These areas ran through all plots in a similar way. Significantly more plants per acre were observed in the untreated check plots at the Lott site (Table 3A). There was a trend toward an increase in pod numbers in the Headline treatment, but this difference was not significant. Neither of these differences translated into significant yield effects (Figure 3). At the Freier site, there were no significant differences in plant populations among treatments (Table 3B). Significantly more pods per plant were observed in the Headline treatment (Table 3B). This difference did not translate into a significant yield increase. In fact, the lowest yield at the Freier site was in the Headline treatment (Figure 4).

Table 3 A. Final Plant Population Assessment and Pod Counts observed on 10&11 Oct 2006

Site	Treatment	Population Estimate Plants per acre [a]	Mean Number of Pods per plant ± SEM [b]
Lott	Untreated Check	89,313 ± 5,876	56.67 ± 6.09
	Sprayer Traffic only	69,000 ± 5,262	59.83 ± 4.05
	Headline	60,063 ± 5,487	71.13 ± 6.91
	Quadris	67,813 ± 5,905	58.48 ± 4.95

[a] P = 0.003
[b] P = 0.258

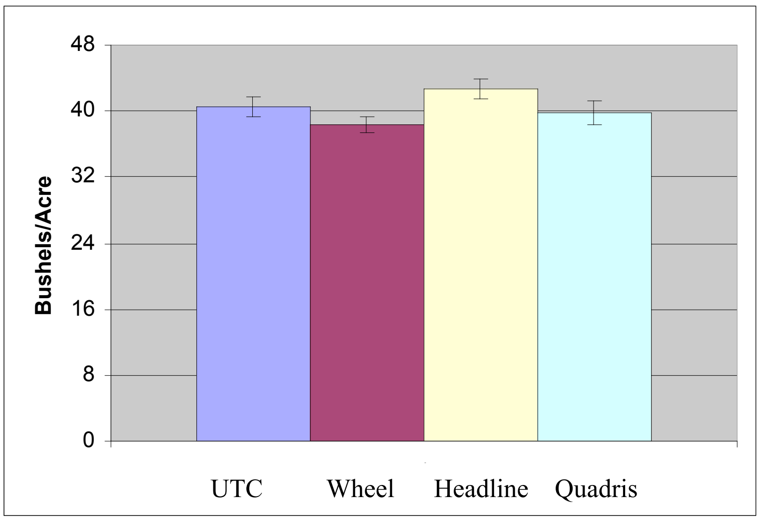
Table 3 B. Final Plant Population Assessment and Pod Counts observed on 12 Oct 2006

Site	Treatment	Population Estimate Plants per acre[a]	Mean Number of Pods per plant ± SEM [b]
Freier	Untreated Check	115,126 ± 7,079	36.80 ± 2.07
	Sprayer Traffic only	106,680 ± 5,732	36.84 ± 2.02
	Headline	107,569 ± 6,883	47.06 ± 3.74
	Quadris	116,459 ± 5,692	39.90 ± 2.08

[a] $P = 0.60$
[b] $P = 0.019$

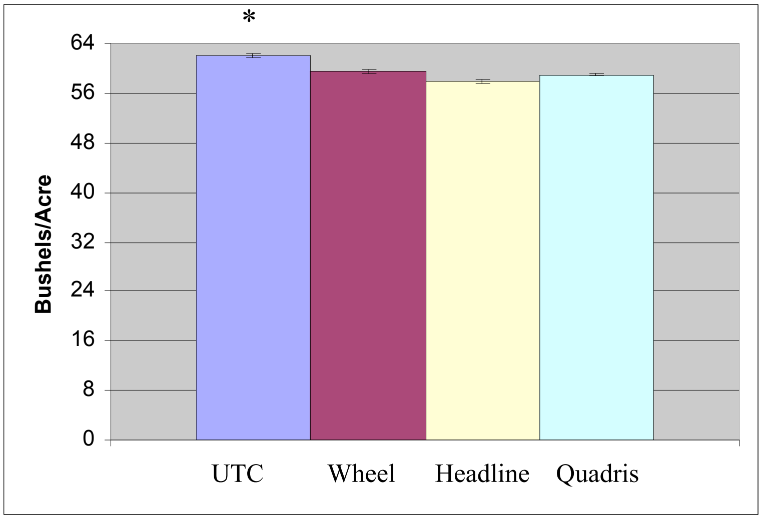
YIELD ASSESSMENT: At the Lott site (Figure 3), analysis of variance shows no significant difference in yield among treatments (P=0.631)

Figure 3. Mean bushels per acre (corrected to 15% moisture) harvested from the Lott site. (Mean ± SEM; P=0.631)



Significant differences were detected in yield at the Freier site (Figure 4, P=0.000). Fisher's LSD test, with 95% confidence intervals, shows that pairwise comparisons among wheel traffic 59.55 bu/acre), Headline (58.02 bu/acre), and Quadris (58.98 bu/acre) treatments are not significantly different, but that the untreated check yielded significantly higher (62.01 bu/acre). Differences observed in yield cannot be accounted for by disease occurrence given that disease differences were not seen among treatments.

Figure 4. Mean bushels per acre (corrected to 15% moisture) harvested from the Freier site. (Mean ± SEM; P=0.000)



PARTIAL BUDGET ANALYSIS: A partial budget analysis was conducted using two scenarios as seen in Table 4. Scenario 1 shows the partial budget comparing the use of Headline fungicide to the current practice of no fungicide application (the check treatment). The check treatment at the Freier site had a higher yield than the Headline treatment and the results of this are shown under decrease in income. The Headline treatment shows a decrease in income $23.94 per acre using a current cash soybean price of $6.00 per bushel. The higher yielding check treatment is the reason for this reduction in income because of the associated yield penalty incurred with the Headline treatment. Added costs in this scenario include Headline at $11.52 per acre and the cost of the custom applicator to apply the fungicide. The applicator cost was $8.75 per acre. The Headline fungicide treatment shows a change in profit of ($44.21) per acre. Applying Headline fungicide the Freier site incurred a $44.21 per acre decline in potential profit.

Scenario 2 shows the partial budget comparing the use of Quadris fungicide to the current practice of no fungicide application (the check treatment). The check treatment at the Freier site had a higher yield than the Quadris treatment and the results are shown under the decrease in income. The Quadris treatment shows a decrease in income of $18.18 per acre using a current cash soybean price of $6.00 per bushel. The higher yielding check treatment is the reason for this reduction in income because of the associated yield penalty incurred with the Quadris treatment. Added costs in this scenario include Quadris at $12.06 per acre and the cost of the custom applicator to apply the fungicide. The applicator cost is $8.75 per acre. The Quadris fungicide treatment shows a change in profit of ($38.99) per acre. Applying Quadris fungicide at the Freier site incurred a $38.99 per acre decline in potential profit.

Partial budget analysis was inappropriate for the wheel tracks treatment (because this practice would never be implemented by a grower). However, it is still useful to look at the numbers. The wheel tracks treatment showed a reduction in yield of 2.46 bushel per acre in comparison with the check treatment. This difference equates to $14.76 based on the $6.00 per bushel market value. The results of this treatment show that the presumed average yield loss of 3-4 bushels per acre may overestimate the actual losses incurred from wheel traffic alone.

Table 1: Freier Partial Budget

Use of Preventive Fungicide on Soybean vs Current Non-use of Preventitive Fungicide on Soybean

Yields:	
Check	62.008
Wheel	59.548
Headline	58.018
Quadris	58.976

Scenario 1: Headline Fungicide

Increase in Profit				**Decrease in Profit**			
Increase in Income				*Decrease in Income*			
					Check	62.008	bu
					Headline	58.018	bu
					Difference	3.99	bu
				Current Market Price			
					$6.00/bu	$23.94	
	Subtototal	$0			Subtototal	$23.94	
Decreased Costs				*Increased Costs*			
				Headline cost/ac		$11.52	
				Application cost/ac		$8.75	
	Subtototal	$0			Subtototal	$20.27	
	Total (A)	$0			**Total (B)**	$44.21	
			Total Change in Profit (A-B)			($44.21)	

Scenario 2: Quadris Fungicide

Increase in Profit				**Decrease in Profit**			
Increase in Income				*Decrease in Income*			
					Check	62.008	bu
					Quadris	58.976	bu
					Difference	3.03	bu
				Current Market Price			
					$6.00/bu	$18.18	
	Subtototal	$0			Subtototal	$18.18	
Decreased Costs				*Increased Costs*			
				Quadris cost/ac		$12.06	
				Application cost/ac		$8.75	
	Subtototal	$0			Subtototal	$20.81	
	Total (A)	$0			**Total (B)**	$38.99	
			Total Change in Profit (A-B)			($38.99)	

A partial budget analysis was conducted using two scenarios as seen in Table 4: Lott Partial Budget. Scenario 1 shows the partial budget comparing the use of Headline fungicide to the current practice of no fungicide application (the check treatment). The check treatment at the Lott site had a lower yield than the Headline treatment and the results of this are shown under increase in income. The Headline treatment in this case resulted in a $13.62 per acre advantage using a current cash soybean price of $6.00 per bushel. Added costs associated with the Headline practice were $11.52 for product and $5.25 per acre application cost. Note in this case that the application equipment is owned by the farm and $5.25 is the associated operating cost per acre. Total added cost is $16.77. The Headline fungicide treatment shows a change in profit of ($3.15) per acre. Although the Headline treatment showed a yield advantage to the check treatment it was not enough to compensate for the $16.77 added cost of application and product.

Scenario 2 shows the partial budget comparing the use of Quadris fungicide to the current practice of no fungicide application (the check treatment). The check treatment at the Lott site had a higher yield than the Quadris treatment and the results are shown under the decrease in income. The Quadris treatment resulted in a $3.72 decrease in income per acre using a current cash soybean price of $6.00 per bushel. The higher yielding check treatment is the reason for this reduction in income because of the associated yield penalty incurred with the Quadris treatment. Added costs in this scenario include Quadris at $12.06 per acre and the application cost. As in scenario 1 cost of application is $5.25 per acre. Total added cost is $17.31 per acre. The Quadris fungicide treatment shows a change in profit of ($21.03) per acre. Total net effect of the Quadris fungicide is $21.03 per acre. Applying Quadris fungicide at the Lott site incurred a $21.03 per acre decrease in potential profit.

Partial budget analysis was inappropriate for the wheel tracks treatment (because this practice would never be implemented by a grower). However, it is still useful to look at the numbers. As was the case at the Freier site there was a yield penalty associated with the wheel tracks treatment. In this case a 1.81 bushel per acre yield penalty was recorded versus the check treatment. This difference equates to $10.86 per acre based on the $6.00 per bushel market value. This treatment indicates that that an average rule of thumb regarding yield loss due to equipment damage of approximately 3-4 bushel per acre may overestimate the expected loss.

Table 2: Lott Partial Budget

Use of Preventive Fungicide on Soybean vs Current Non-use of Preventitive Fungicide on Soybean

Yields:	
Check	40.498
Wheel	38.687
Headline	42.77
Quadris	39.88

Scenario 1: Headline Fungicide

Increase in Profit					**Decrease in Profit**			
Increase in Income					*Decrease in Income*			
	Headline	42.77	bu					
	Check	40.498	bu					
	Difference	2.27	bu					
Current Market Price								
	$6.00/bu	$13.62						
	Subtotal	$13.62				Subtotal	$0	
Decreased Costs					*Increased Costs*			
					Headline cost/ac		$11.52	
					Application cost/ac		$5.25	
	Subtotal	$0				Subtotal	$16.77	
	Total (A)	$13.62				**Total (B)**	$16.77	
				Total Change in Profit (A-B)			($3.15)	

Scenario 2: Quadris Fungicide

Increase in Profit					**Decrease in Profit**			
Increase in Income					*Decrease in Income*			
						Check	40.498	bu
						Quadris	39.88	bu
						Difference	0.62	bu
					Current Market Price			
						$6.00/bu	$3.72	
	Subtotal	$0				Subtotal	$3.72	
Decreased Costs					*Increased Costs*			
					Quadris cost/ac		$12.06	
					Application cost/ac		$5.25	
	Subtotal	$0				Subtotal	$17.31	
	Total (A)	$0				**Total (B)**	$21.03	
				Total Change in Profit (A-B)			($21.03)	

In all scenarios analyzed from both the Freier and the Lott sites, there was no economic advantage to the application of preventative soybean fungicides in the absence of soybean rust or other disease pressure in this experiment. Based on this research and the current cash price for soybean one would need a 3.4 and a 3.5 bu per acre yield advantage or gain threshold to cover added costs of the Headline and Quadris fungicide programs, respectively (at the Freier site). At the Lott research site a 2.8 and 2.9 bu per acre gain threshold is needed to cover added costs of the Headline and Quadris fungicide programs, respectively. In regards to equipment (wheel) damage it appears that yield depression averaged 2.1 bushel per acre across both sites. Yield reduction was higher at the Freier site, planted in 7 in. row spacing, versus the Lott site planted at 15 in. row spacing.

The economic findings presented allow for the projection of potential increases or decreases in profit based on at least two factors. These factors include current or forecasted grain price and equipment hire versus ownership. The results of this research show a significant difference in yield between the check and other treatments at the Freier site indicating that a yield depression needs to be overcome in addition to a yield boost needed to cover the gain threshold. The same may be said in regard to the Lott data. In this case there was no significant difference across all treatments, indicating that a yield boost would only be needed to cover the gain threshold. In a year of elevated grain prices, one could lower the gain threshold for the practice of fungicide application. For example a price per bushel of $8.50 would reduce the average gain threshold (in the case of Headline) by one bushel per acre at both sites. Note at the Lott site application cost per acre is $3.50 less than that at the Freier site, otherwise the gain threshold would be the same at both. This illustrates the slight advantage of equipment ownership versus hire.

Data from this one year study provides insights into the potential economic and yield impacts of fungicide applications without observable soybean disease pressure. Soybean producers should use caution when considering the practice of foliar fungicide applications at the R3-R4 plant growth stage. Producers should be encouraged to always leave an untreated test strip when a new practice, such as fungicide application, is implemented on their farm so that they are able to determine the value of the practice under their own farm conditions. Further studies looking at a range of soybean varieties in more locations will further enhance the validity of these results. Environmental influences, including temperature and rainfall, can greatly affect disease pressure and overall plant health. These studies would need to be repeated in another growing season to further investigate the validity of the results under a wider range of climatic conditions.

OUTREACH EFFORTS: Implementation of the outreach program and evaluation of impacts will take place from January 2007 through the 2007 growing season.

Project Locations: Results will be relevant nationally.

Samples of Resources Developed:
A brochure will be developed in January 2007 to distribute at winter crop meetings. A copy will be submitted to NYS IPM upon completion to accompany this report.

The following photographs were taken during the course of the research:

Joi Strauss, field scout, makes observations of soybean diseases while Mike Dennis, Seneca County CCE, records the data

Joi Strauss and Mike Dennis count numbers of pods per plant

Mike Dennis assess final plant stand using the hoop method


The combine reaches the end of a plot during harvest at Freier’s field site


Harvest is halfway done at Freier’s. Can we take out the flags yet?


Mike Dennis takes a sub-sample for soybean quality analysis

The combine dumps a load into the truck. Next, the truck will go to the scales to weigh the yield of a plot.